



# Rice-specific LTILRP Groundwater Assessment and WDR: Background & Overview



Prepared by



CH2MHILL.

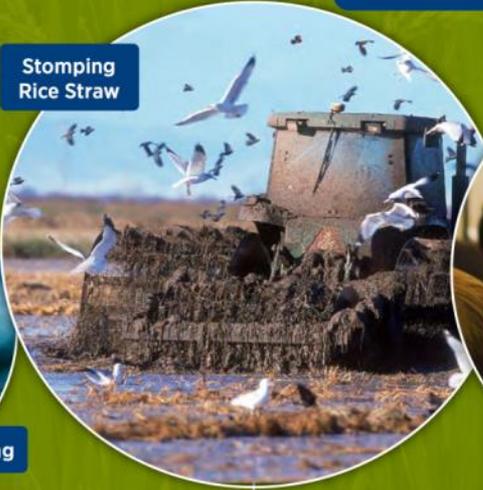
PLANTIERRA

# California Rice

an industry changes...



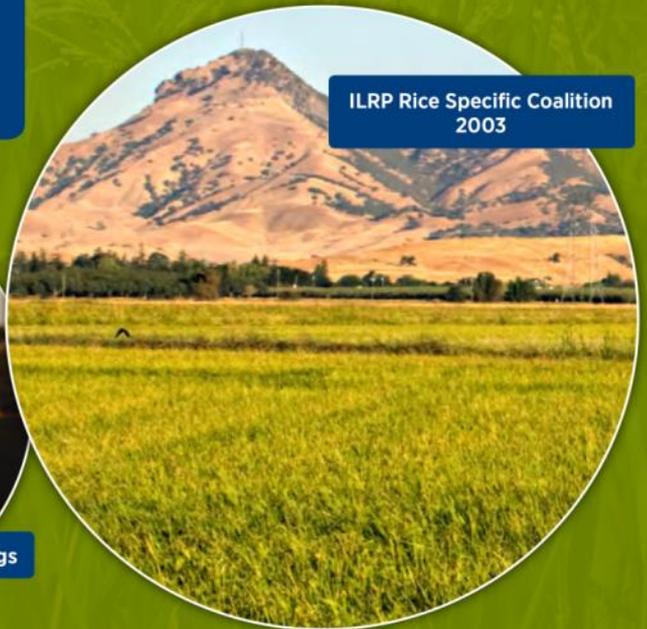
Rice Burning



Stomping Rice Straw



Mandatory Meetings



ILRP Rice Specific Coalition 2003

1980

2013



Collaborative Work  
RWB, DPR, FWS,  
UC, Industry

60 Sites Monitored



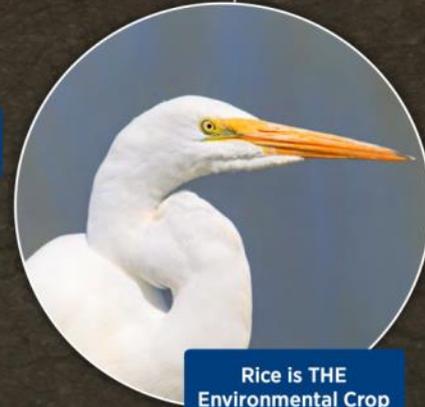
Water Holds



Pesticides Degrade

CRC Takes Over RPP

Seepage Inspections

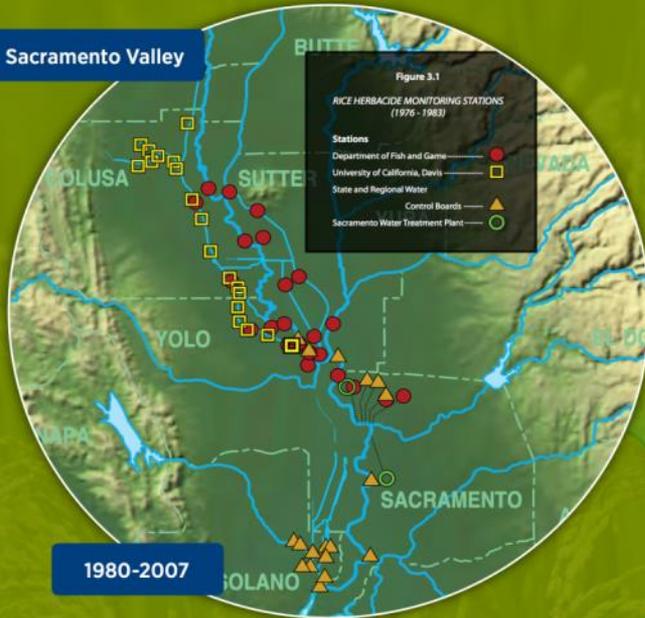


Rice is THE Environmental Crop

# Applying Learning

## Irrigated Lands Program

Sacramento Valley

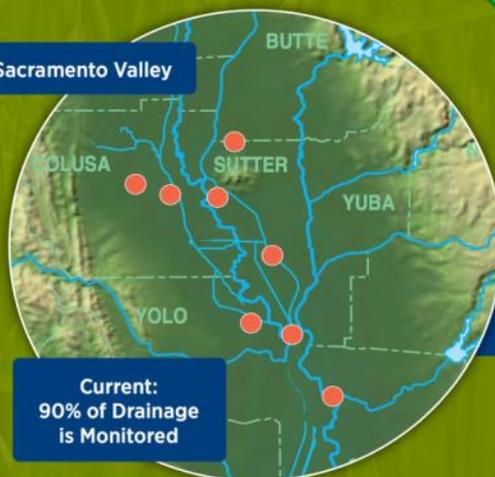


U.S. EPA DPR

2003 PUR DATA - TOXICITY SUMMARIES

VALUE (UG/L)	TYPE (SPECIES)	SOURCE (AQUIRE OR DPR [REFERENCE])	CHANGE IN USE PATTERN	RECOMMENDATION	
				YES	NO
500	96-hr LC <sub>50</sub> [Rana sierrae (leopard frog)]	AQUIRE [Linder, G. J. Barbita, and T. Kwaizer. 1990. Short-Term Amphibian Toxicity Tests and Parasit Toxicity Assessment. In: W.G. Landis and W.H. Van der Schalie (Eds.), Aquatic Toxicology and Risk Assessment, Thirtieth Vol., ASTM STP 1096, Philadelphia, PA:189-198. Reference #13295]	Usage began in 1996 with less than 2,000 acres treated annually.		NO. Limited
50	96-hr LC <sub>50</sub> [Oncorhynchus mykiss (rainbow trout)]	AQUIRE [Kikuchi, M., T. Miyagaki, and M. Watabayashi. 1996. Evaluation of Pesticides Used in Golf Links by Acute Toxicity Test on Rainbow Trout. Bull. Jpn Soc Sci. Fish. (Nippon Suisan Gakkaishi) 62(3):414-419 (JPN) (ENG ABS). Reference #18916]	Usage began in 1996 with less than 3,000 acres treated annually. The product is a pre-plant for GRB seeded rice.		NO. Limited usage.
350	48-hr LC <sub>50</sub> [Carassius auratus (goldfish)]	AQUIRE [Nishuchi, Y., and Y. Hashimoto. 1969. Toxicity of Pesticides to Some Fresh Water Organisms. Rev. Plant Protec. Res. 2:137-139. Reference # 2663]	Usage steadily increased since 1998. The 2003 usage was 312,139 acres.	YES. In rotation. Possibly monitoring in 2006.	
330	96-hr LC <sub>50</sub> [Cyprinus carpio]	AQUIRE [Sun, F. 1987. Evaluating Acute Toxicity of Pesticides to Aquatic Organisms: Carp, Mosquito Fish and Daphnia. Plant Prot. Bull. (Chin. Yu Pei Hu Hsueh Hui Hui Kan) 29(4):385-396 (CHI) (ENG ABS). Reference #13451]	A herbicide currently monitored under the Basin Plan's Rice Pesticides Program.		NO. Not included in the CRC MPP because monitoring takes place under the Rice Pesticides Program.
104,000	96-hr LC <sub>50</sub> [Pimephales promelas (fathead minnow)]	AQUIRE [Mayes, M.A., D.C. Die, K.M. Bodner, and C.G. Mendoza. Toxicity of Triethylamine Salt Toxicity to Life Stages of the Fathead Minnow (Pimephales promelas Rafinesque). Bull. Environ. Contam. Toxicol. 33(3):335-347. Reference #10699]	Usage began in 1995. The 2003 usage was 242,478 acres.	YES. In rotation.	
400	96-hr LC <sub>50</sub> [Oncorhynchus mykiss (rainbow trout)]	AQUIRE [Office of Pesticide Programs. 2000. Pesticide Ecotoxicity Database (Formerly: Environmental Effects Database (EEDB)). Environmental Fate and Effects Division, U.S. EPA, Washington, D.C. Reference #344]	Usage began in 1997. The only fungicide used on rice. No fungicides are listed for monitoring in the Water Average use is 46,268 acres.		

Sacramento Valley



**ANNUALLY:**  
Key Pesticides & Core Constituents

# Advancing into the WDR



- CRC used same successful principles
  - *Surface water started with the Rice Pesticides Program and Irrigated Lands Program*
  - *Ground water starts with Ground Water Assessment Report to summarize existing data specific to rice*
    - Includes newly developed data from UC Davis through the Rice Research Board
    - Provides the scientific basis for a rice-specific WDR through the conceptual model

# Groundwater Assessment



# Groundwater Assessment



- Purpose:

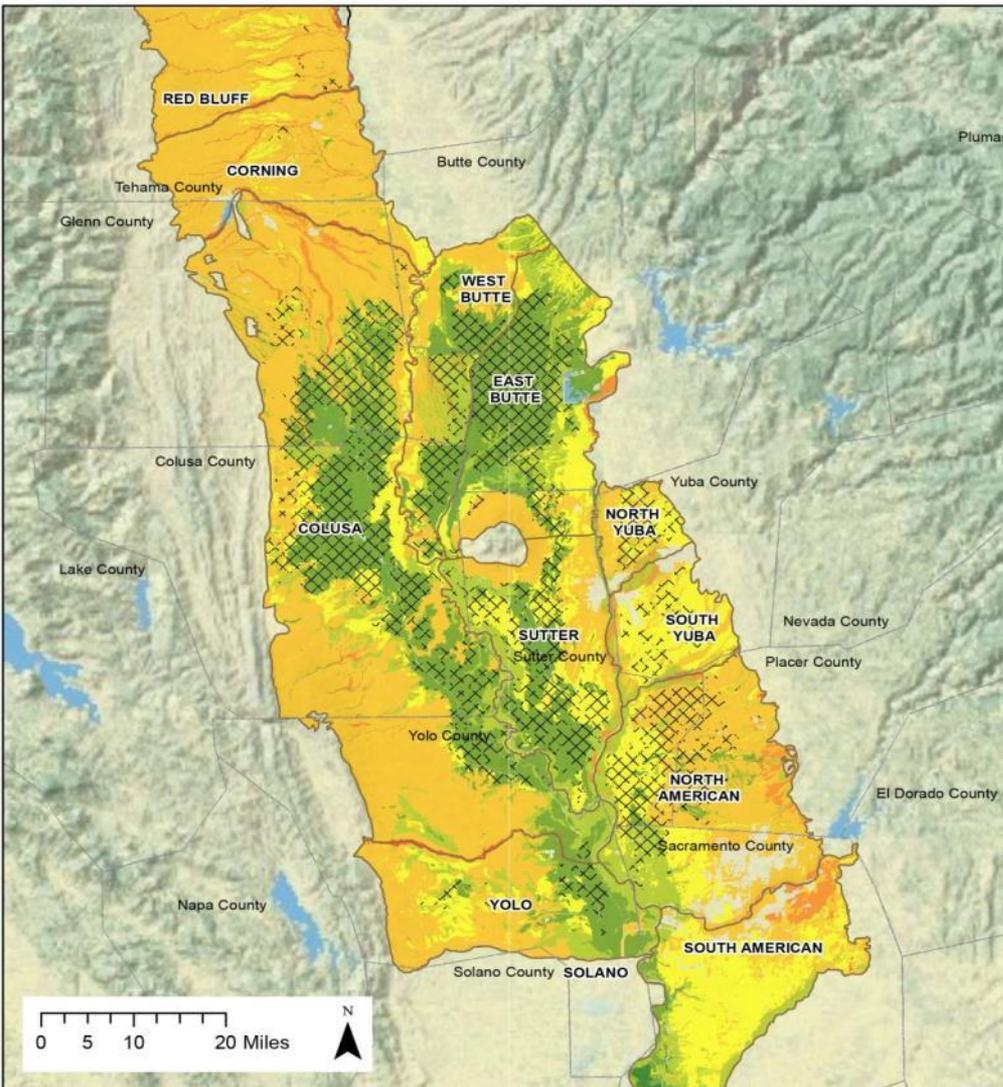
- *Develop technical analysis to support long-term monitoring and implementation recommendations*

- Approach:

- *Evaluate field and soil environment*
- *Assess historic groundwater quality data*
- *Evaluate vulnerability*

## Rice Lands

- Groundwater quality generally high
- Contiguous blocks of continuous rice
- Relatively consistent farming practices since about 1982
- Grown on low permeability soil
- Rice sensitive to over-fertilization
- Mainly applied & maintained as ammonia-n ( $\text{NH}_3$  or  $\text{NH}_4$ ), not  $\text{NO}_3\text{-N}$



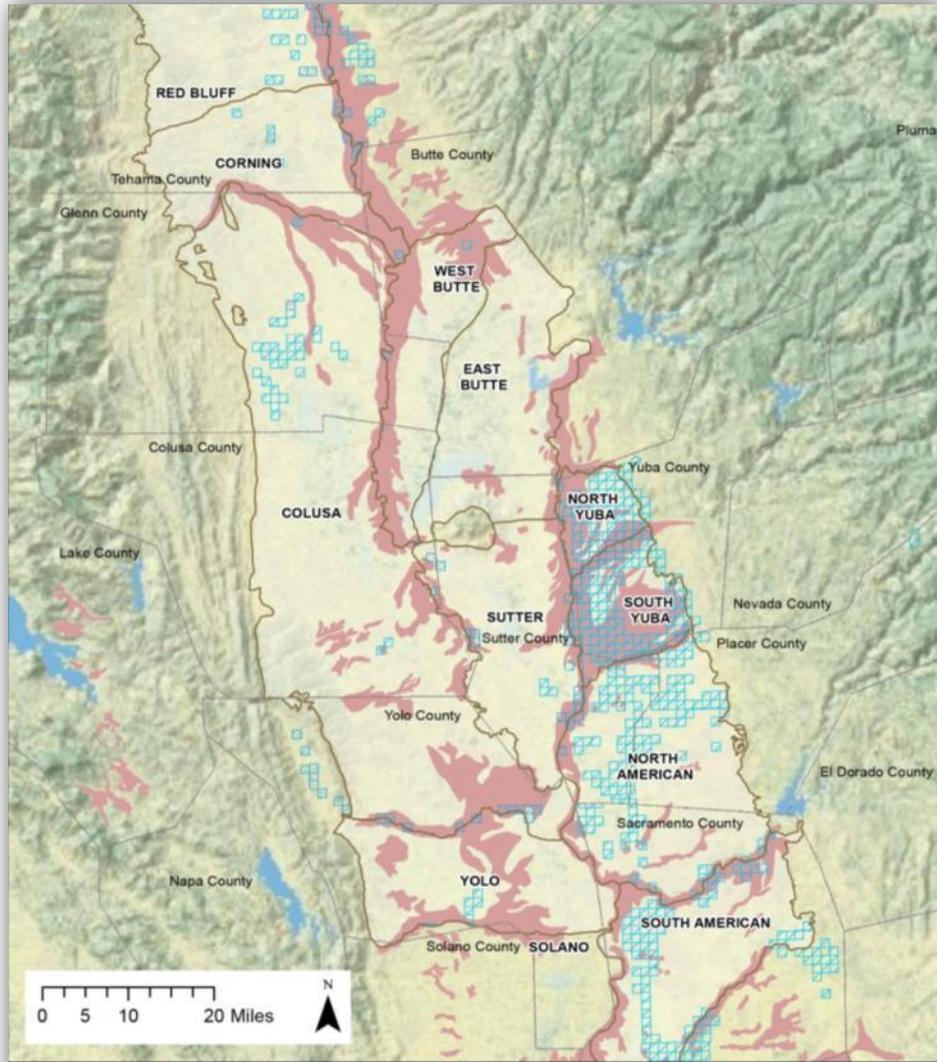
Data Sources: Groundwater Basins, Rice Crop (California DWR 2010); Drainage Class (NRCS 2012); Basemap, County (ESRI 2011). Datum is NAD83.

### Legend

<b>NRCS Soil Drainage Class</b>	County Boundary
Very poorly drained	Groundwater Basins
Poorly drained	Rice Lands (DWR)
Somewhat poorly drained	
Moderately well drained	
Well drained	
Somewhat excessively drained	
Excessively drained	

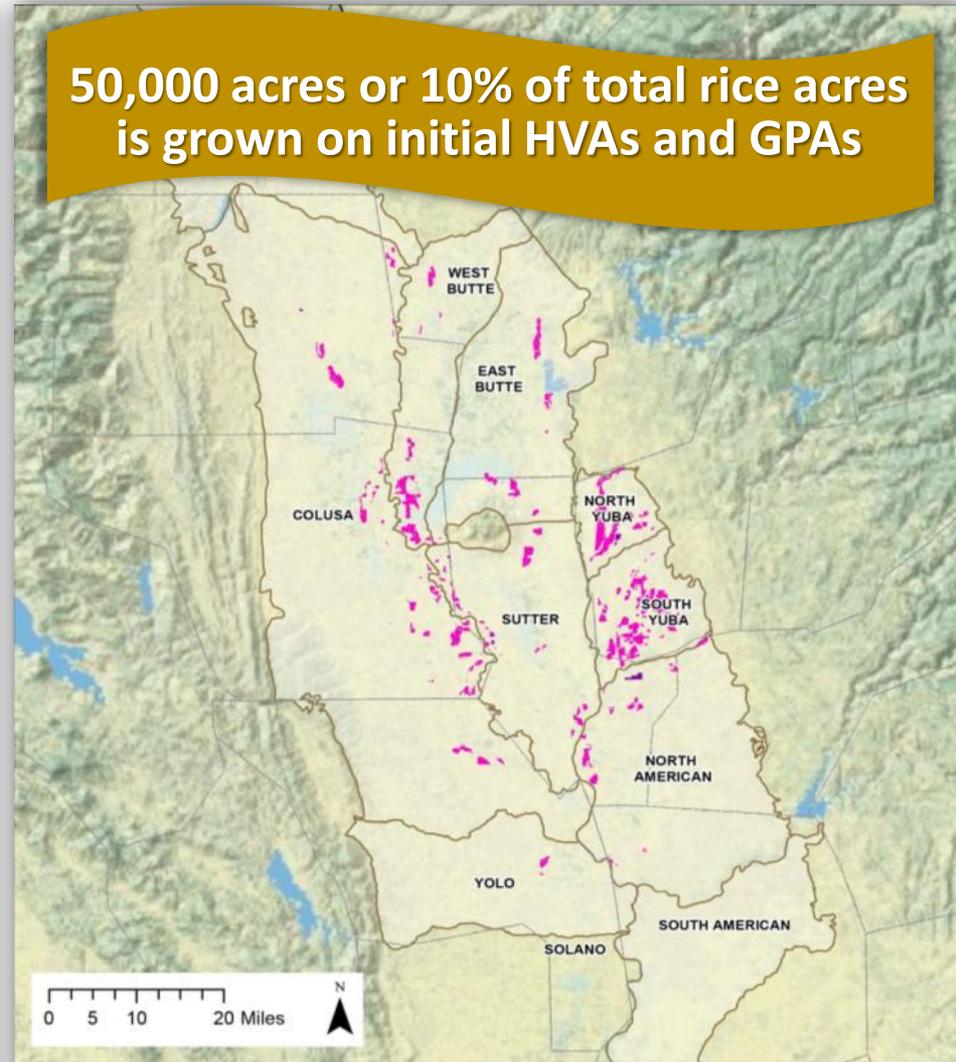
Note: Figure from the Rice-Specific Groundwater Assessment Report, Map 2-7.

## SWRCB Initial Vulnerability Areas and DPR Groundwater Protection Areas



## Rice Within SWRCB Initial Vulnerability Areas and DPR Groundwater Protection Areas

50,000 acres or 10% of total rice acres is grown on initial HVAs and GPAs



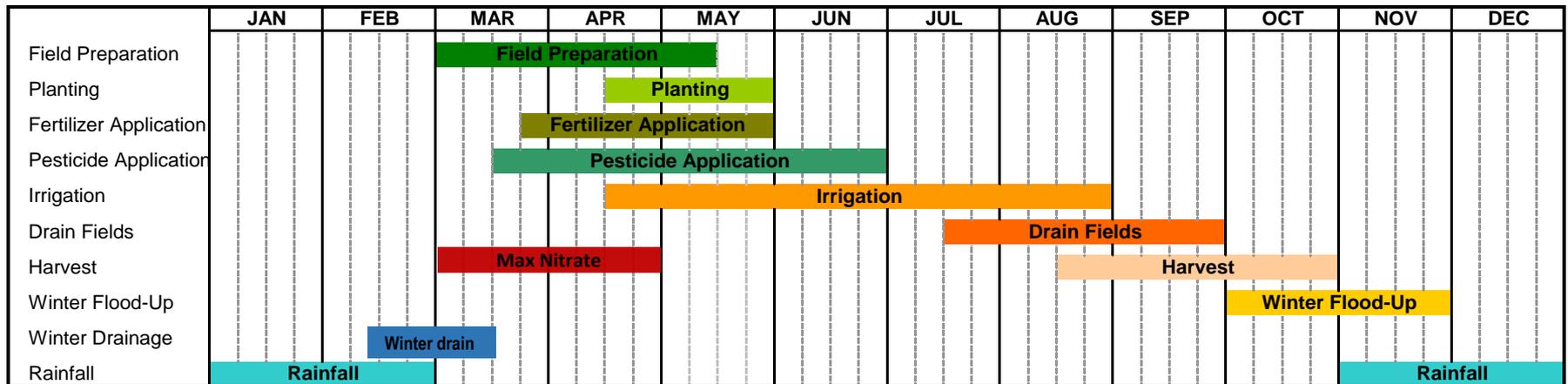
- SWRCB Initial HVA
- DPR GPAs
- Leaching
- Runoff
- Runoff or Leaching
- County Boundary
- Groundwater Basins

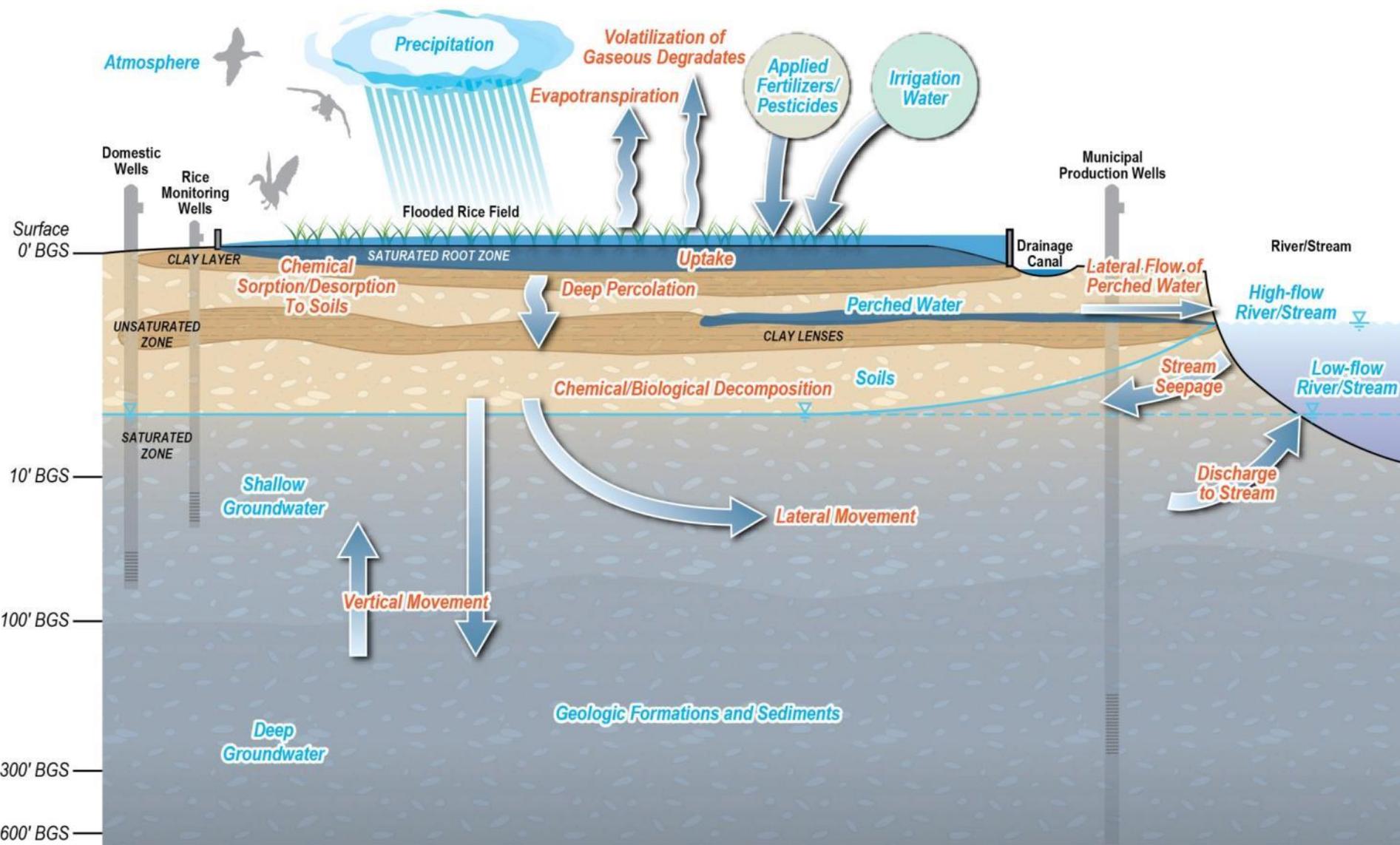
- Rice within Initial SWRCB HVA
- Rice within DPR Leaching and Leaching or Runoff GPA
- County Boundary
- Groundwater Basins

# Conceptual Model Components



- Aboveground (fertilization, irrigation, volatilization)
- Root zone (storage, transformations, uptake, leaching, volatilization, permeability)
- Groundwater (connectivity to rice field root zones, influence of other sources)





**LEGEND**

■ Pathways and Transformations

■ Sources and Sinks

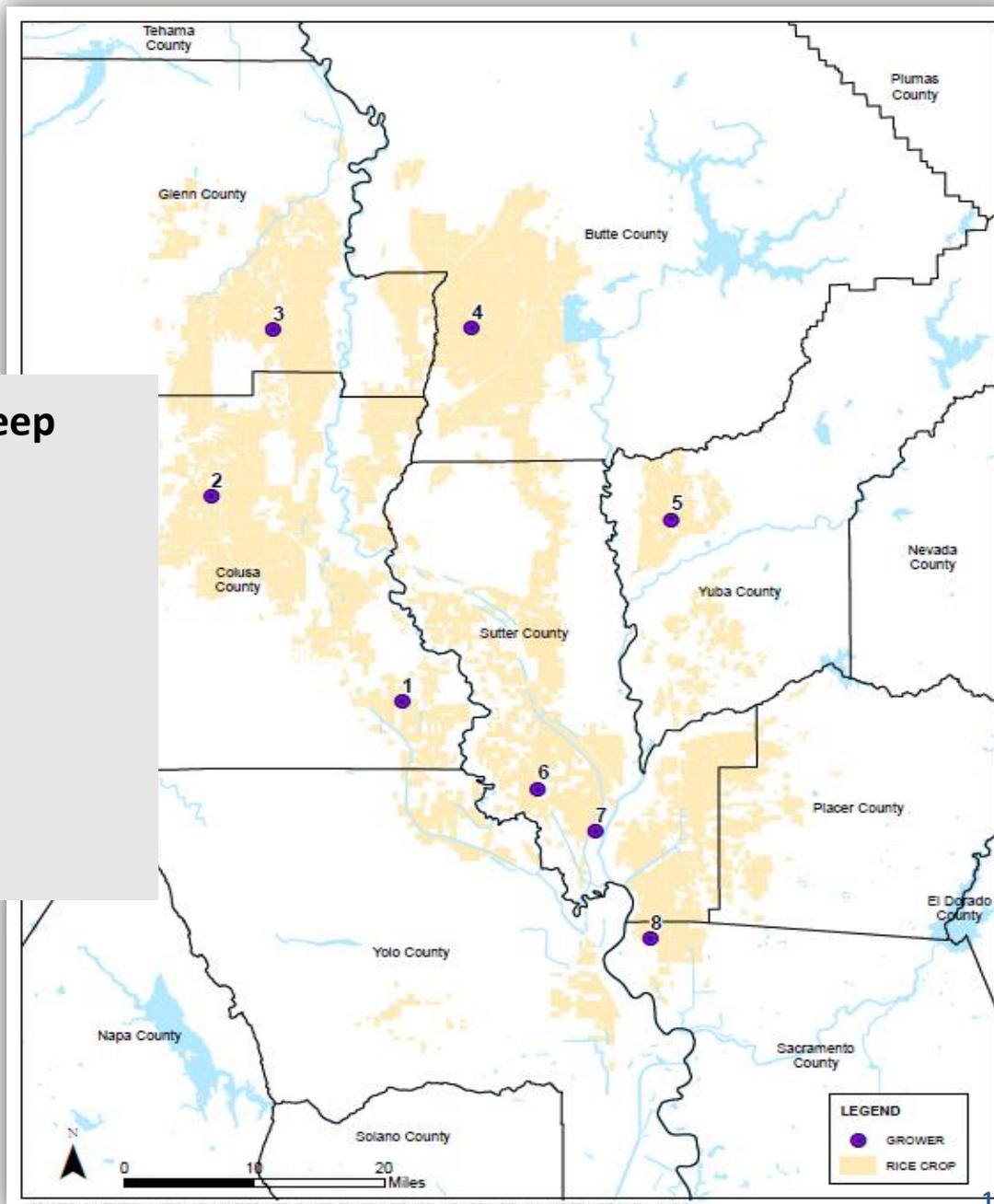
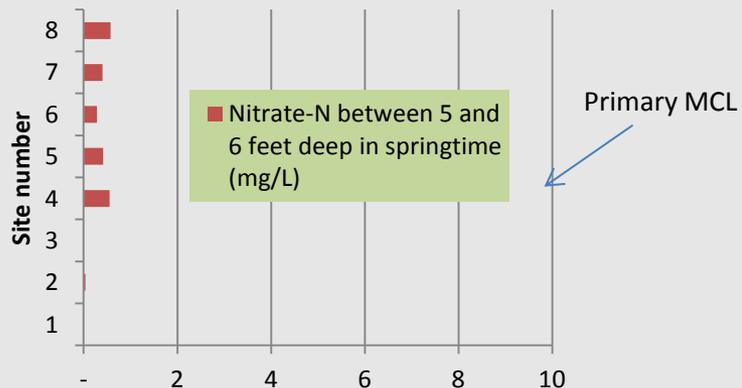
The features on this diagram are intended to be broadly representative of physical and chemical conditions encountered in a typical rice field, and are not intended to represent exact conditions in every rice field.

Note: Figure from the Rice-Specific Groundwater Assessment Report, Figure 2-2.

NOT TO SCALE

# Root-zone Study (UCCE) 2011-

Nitrate-N between 5 and 6 feet deep  
in springtime (mg/L)



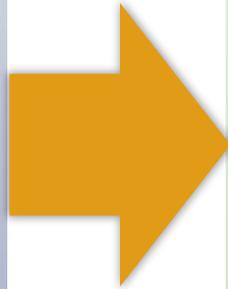
# Groundwater Data Quality Analysis



# Screening Criteria to Select Datasets for Rice-Specific Vulnerability Analysis

## Key Features of Selected Datasets

- Proximity to rice
- Range of constituents
- Range of depths: Shallow, medium, and deep groundwater
- Documented, peer-reviewed, or published



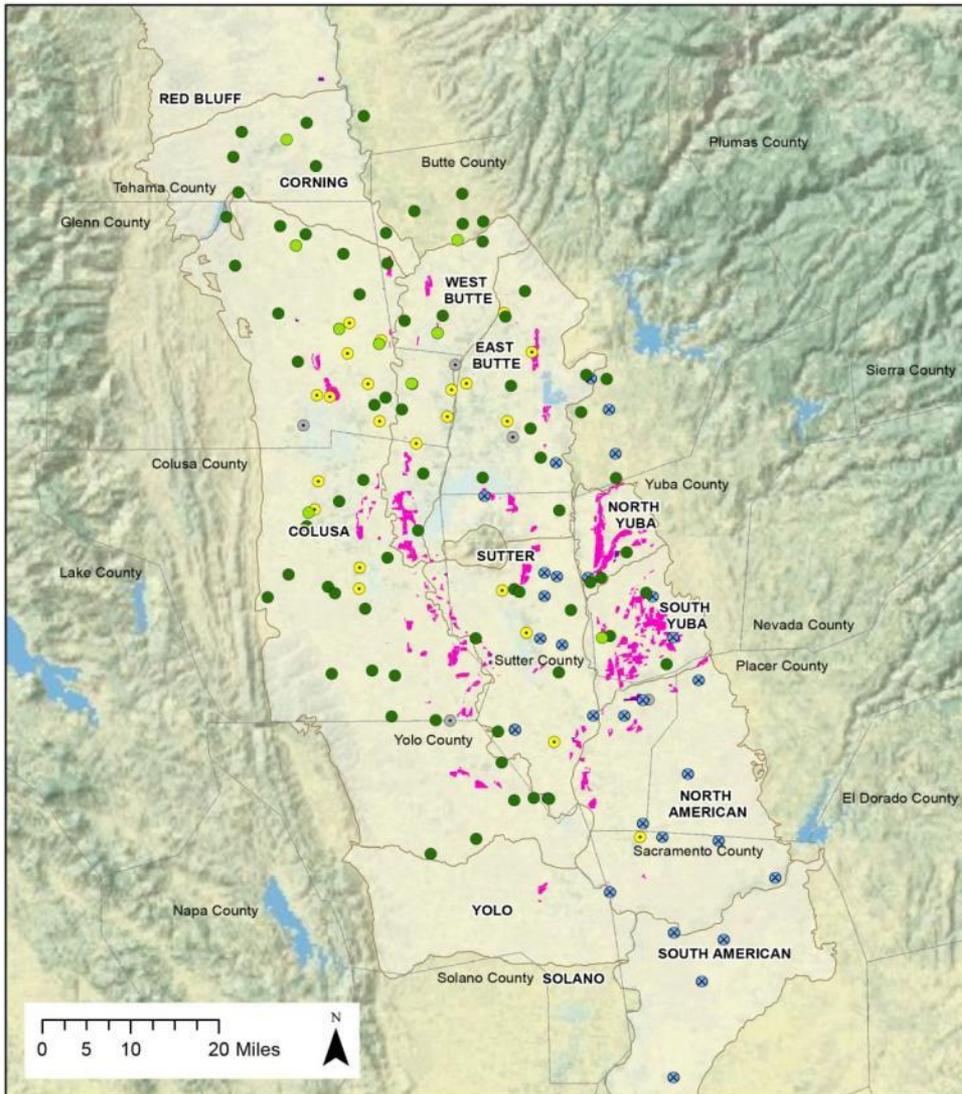
## Compared Groundwater Quality Results\*

- Nutrients (Nitrate , Phosphorus, potassium, sulfur, zinc, iron)
- Salinity (TDS, specific conductance)
- Pesticides registered for use on rice
- Metals and non-metals

*\*Compared to drinking water standards and other triggers*

# *Evaluated Well Networks*

Shallow and Deep Well Networks Overlying the Initial HVAs and GPAs in Rice Fields



Data Sources: Groundwater Basins, Rice Crop (California DWR 2010); Basemap, County (ESRI 2011), USGS (2008). Datum is NAD83.

## Legend

- ⊗ USGS Shallow Domestic Wells
- ⊙ USGS Rice Wells
  - Active Monitoring Well
  - ⊙ Abandoned Monitoring Well
- ⊙ USGS GAMA Wells
  - Grid Well
  - Flow Path Well
- Rice within Initial SWRCB HVA
- Rice within DPR Leaching and Leaching or Runoff GPA
- County Boundary
- Groundwater Basins

# Nitrate Results for All Well Networks

## Legend

### USGS Rice Wells

- <5 mg/L NO<sub>2</sub>+ NO<sub>3</sub>-N
- 5 mg/L - 10 mg/L NO<sub>2</sub>+ NO<sub>3</sub>-N

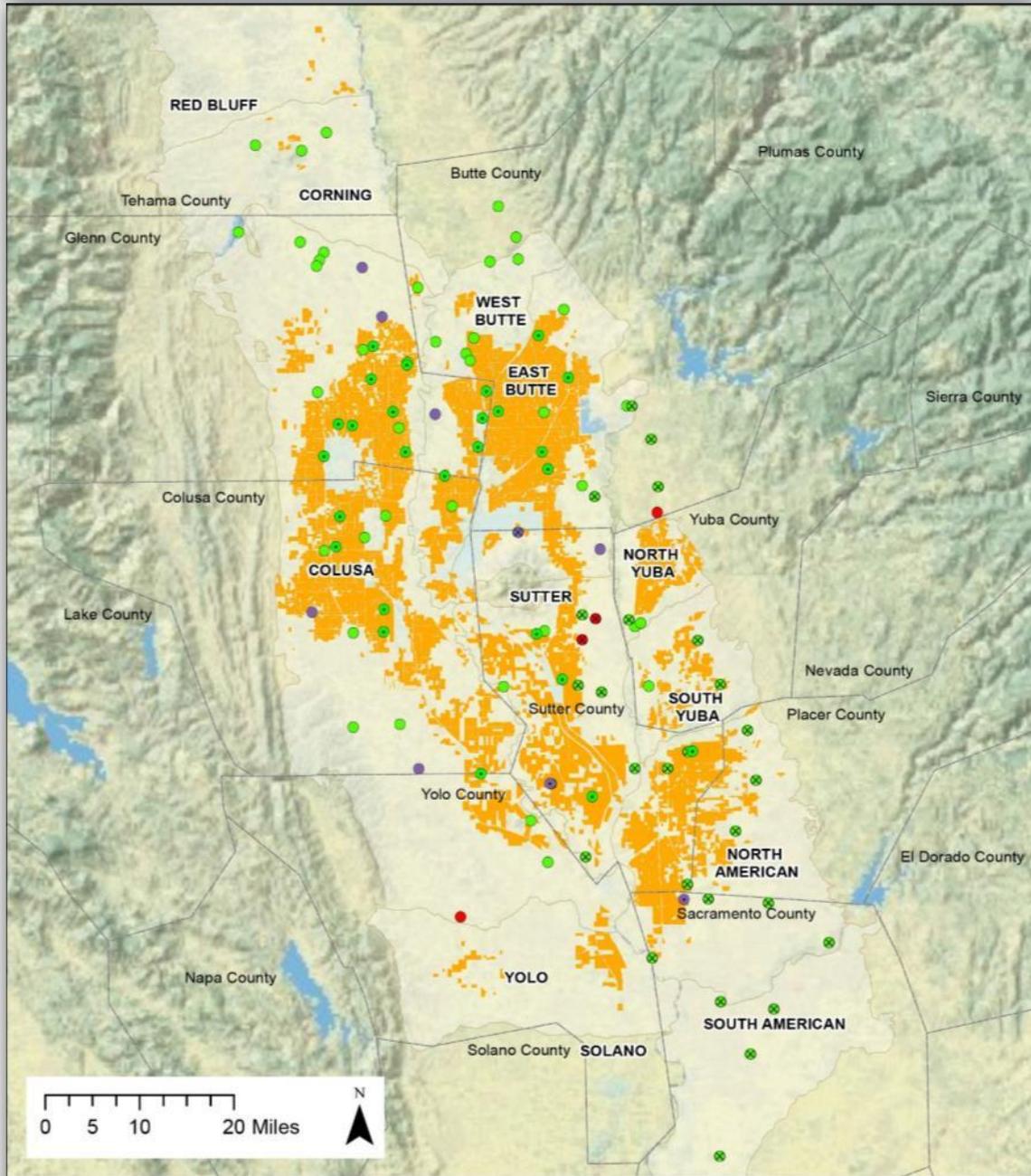
### Shallow Domestic Wells

- ⊗ < 5 mg/L NO<sub>2</sub>+NO<sub>3</sub>-N
- ⊗ 5 mg/L - 10 mg/L NO<sub>2</sub>+NO<sub>3</sub>-N
- ⊗ > 10 mg/L NO<sub>2</sub>+NO<sub>3</sub>-N

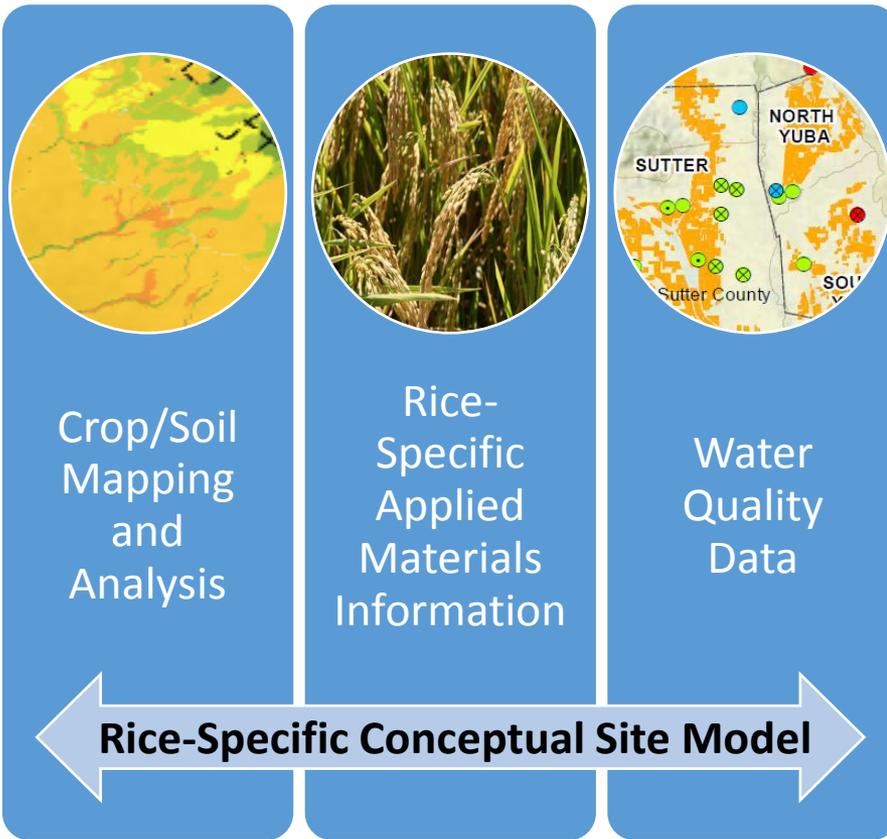
### GAMA Wells

- <5 mg/L NO<sub>2</sub>+ NO<sub>3</sub>-N
- 5 mg/L - 10 mg/L NO<sub>2</sub>+ NO<sub>3</sub>-N
- >10 mg/L NO<sub>2</sub>+ NO<sub>3</sub>-N

- County Boundary
- Rice Lands (DWR)
- Groundwater Basins



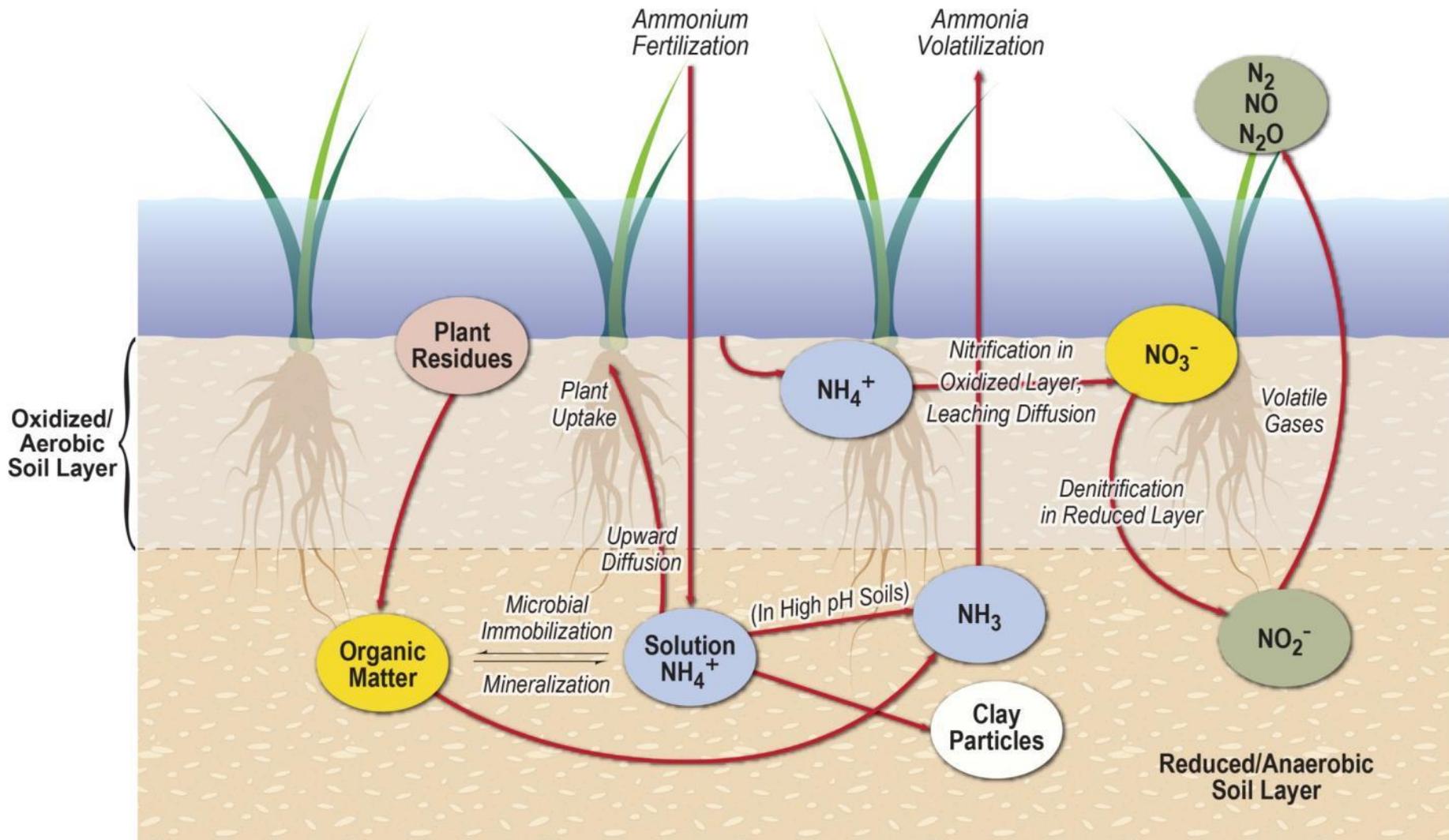
# Groundwater Assessment Summary



- Multiple lines of evidence
- Low risk
  - Nitrate in USGS Rice Wells below the MCL
  - No confirmed detections of pesticides registered for use on rice
- Analysis forms basis for Trend Monitoring Program

# Discussion/Questions?





Source: Modified from Figure 4.2, UC-ANR 2010.

NOT TO SCALE

**Hydraulic Conductivity,  
20-25 cm depth (cm/d)**

